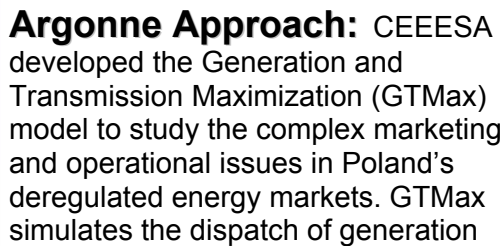




## Economic and Financial Benefits of Distributed Generation Small-Scale Gas-Fired CHP in Poland

Energy Market Agency (EMA), trained a group of experts from the agency to use the model, and provided ongoing technical support to the team. By using GTMax's powerful graphical user interface, EMA was able to quickly build a network representation of the Polish power system topology and analyze a variety of scenarios.



The screenshot displays the GTMax software interface, which is used for simulating and analyzing power systems. The main window, titled "Case: New Blank", shows a detailed network diagram. The interface includes a menu bar at the top with options like File, Edit, View, Select, Window, and Help. Below the menu bar is a toolbar with various icons for file operations, simulation, and analysis. The main window is divided into several sections: "Node Data", "Reservoir Data", "Transmission Link Data", and "Heat Pipeline Data". Each section has a dropdown menu for selecting the data type. The "Hourly Energy Balance" section shows a table with columns for Year, Week, Day, Hour, and Statistics. The main diagram area shows a complex network of nodes and connecting lines. Nodes are represented by colored diamonds (blue, red, green) and are labeled with numerical values. Lines connecting the nodes are labeled with flow values. The network is interconnected, showing a complex web of connections between various components. The status bar at the bottom indicates "GTMax Ready".

**Scope of Work:** EMA staff used GTMax to track hourly energy transactions, the price of energy delivered to regional market hubs, and production costs. The model can be run for all 52 weeks in a year or for selected weeks. In this study, the model was run for the week with the highest hourly load (week 48) to estimate the costs and revenues associated with operating the CHP plants.

The CHP plants were assumed to use reciprocating engines fueled by natural gas with an output of 24 MWe. The plants operate only during the heating season at times of high loads. The operation is regulated for heat on a seasonal basis, taking advantage of on-site heat storage capabilities. Because the CHP plants are expected to be located very near the load centers, transmission losses are negligible.

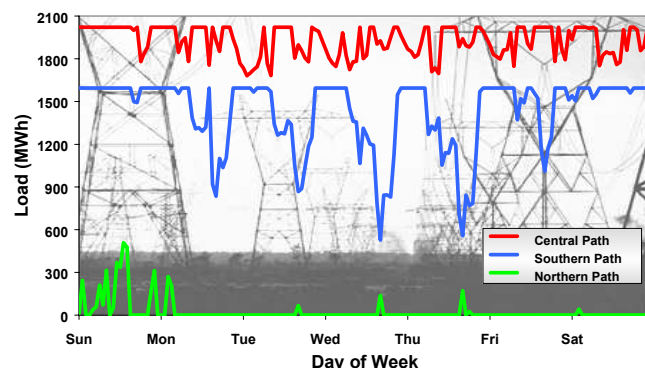
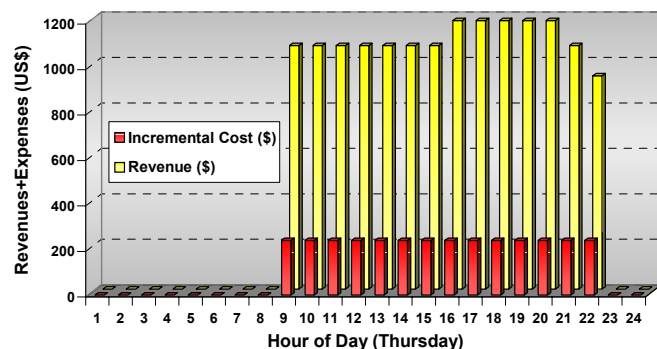
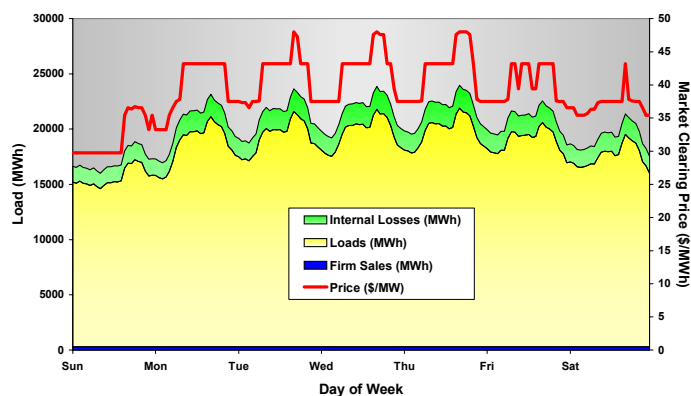
The transmission system in GTMax includes all 400-kV and 220-kV power lines between the five regions as well as between Poland and the European grid (UCPTE). Under normal operating conditions, there are no transmission bottlenecks; however, some transmission paths are, at times, heavily loaded with economic bulk power transfers.

**Results:** Regional price differences are currently small (less than 5%) because the transmission network is not congested. The average projected market price for all five regions ranges from 29.4 \$/MWh on Sunday to almost 50 \$/MWh during late afternoon on three weekdays (see figure). The off-peak price is set by the marginal production cost for CHP plants in the central region; the on-peak price is set by marginal production costs of the pumped storage power plants. Because the northern region currently experiences negative reserve margins, model runs found that this region has the highest marginal value of energy and thereby is the most attractive for new CHP plants.

Revenues and costs for the CHP plants were estimated for the peak load week. In the projected generation pattern, the units are generating electricity at full capacity for 14 hours per day (from 9 am to 10 pm). Revenues were calculated by multiplying the amount of energy sold by the hourly market clearing price.

Incremental production costs are the cost difference between generating heat only and generating both heat and electricity. The short-term net revenues for the week were estimated to be \$86,000. Over the lifetime of the project, the net revenues must be enough to cover all fixed expenses and capital expenditures.

An analysis of available hourly transfer capabilities for potential power transfers from Russia to Germany shows that capabilities are projected to be much larger along the central path, at times exceeding 2,000 MW. The northern path, on the other side, is often at or near its defined transmission transfer capability.



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